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ABSTRACT

Interactive multimedia electronic journals, or IMEJ journals, are a publication medium particularly suited for research in computer-enhanced learning. This paper describes the challenges and potential rewards in publishing such a journal; presents ideas for design and layout; and discusses issues of collaboration, copyrighting, and archiving that are unique to IMEJ publications. Comments, based on the authors' experiences in founding a new IMEJ at Wake Forest University, are directed to those interested in developing their own interactive multimedia electronic journal, publishing their research in such a journal, or considering the evolution of scholarly publication in the light of new technology. (AEF)

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Publishing an *imej* Journal for Computer-Enhanced Learning

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Abstract: *Interactive multimedia electronic journals* (*imej journals*) are a publication medium particularly suited for research in computer-enhanced learning. In this paper, we describe the challenges and potential rewards in publishing such a journal; present ideas for design and layout; and discuss issues of collaboration, copyrighting, and archiving unique to *imej* publications.

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Introduction

Electronic journals have proliferated in the past five years, popularized by their accessibility, searchability, timeliness, and dynamism. Many publishers, universities, professional associations, and grant-supported agencies now offer extensive electronic libraries. Notable among these are Johns Hopkins' Project Muse, VPI's Scholarly Communications Project, Stanford's Highwire Press, Springer's Link collection, ACM's Digital Library, and the Mellon Foundation's JSTOR (Schatz and Chen 1999). (Also see (Treloar 1998) for a short summary of electronic scholarly publishing projects.) The majority of the online publications spawned in these projects are direct translations of existing hard-cover journals to electronic form. But along with these, a large number of entirely new Web-only journals are appearing as well. A good sampling of online journals can be found at http://gort.ucsd.edu/newjour/, which lists thousands.

Web publishers all over the world are attracted to the electronic medium by low start-up costs and the potential for wide and varied kinds of communication. Pictures, scrolling messages, online interviews, and music have become common on popular and commercial Web sites, and scholarly electronic journals are beginning to explore the possibilities of multimedia presentation as well. Art, music, and science journals have been among the first to use multimedia effectively, drawing obvious benefit from the ability to display pictures, play music, or allow readers to visualize the otherwise unseeable.

The other special facility of online communication -- interactivity -- remains relatively unexplored in scholarly communication. Few of the new journals allow readers to interact with what they are reading in ways that go beyond clicking on a play button, following a link, or joining a discussion forum. Interactivity is one of the most engaging features of the Web, and the one which promises to evolve most strikingly as Web technology is developed. Web users are intrigued by their window to the world, through which they can reach in, grab information, find out how things work, and communicate with others far away with an immediacy that never ceases to amaze. In the scholarly world, interactivity has great potential, since it might allow a reader to see, handle, replicate, verify, and truly understand the work of a colleague. Data can be manipulated, graphs redisplayed, programs run, 3-D images rotated, and experiments performed. Such uses of multimedia interactivity would distinguish Web journals as unique and valuable forums for scholarly communication.

Multimedia interactivity of this type is more useful in some academic areas than in others, and computer-enhanced learning is clearly one area where an interactive multimedia presentation would be most to the point. What better way to explain effective uses of the computer in teaching than to *show* the readers what can be done, allowing them to try things out themselves in a dynamic and interactive way? These thoughts were our motivation for the founding of a new interactive multimedia electronic journal at Wake Forest University -- *The IMEJ of Computer-Enhanced Learning* (imej.wfu.edu). In this paper, we tell how we have dealt with the unique problems that arise in the creation of an *imej* journal, and offer our ideas on design and editorial policy. Our comments are directed to those interested in developing their own *imej* journal, publishing their research in such a journal, or considering the evolution of scholarly publication in the light of new technology.

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Content

Computer-Enhanced Learning

Our development of *The IMEJ of Computer-Enhanced Learning* is motivated from three directions. First, we are intrigued by the under-utilized potential of electronic publication. Second, we can see that educators have urgent questions about the value of learning technology, and there are very few places where they can find practicable answers. Many universities -- including Wake Forest -- have adopted new policies for student computer ownership, in some cases providing a laptop for all students, in others requiring that all students buy computers with certain minimum specifications (Brown, Burg, and Dominick 1998). Faculty feel pressed to find good uses for the computers, and their questions are of quite a practical nature: What can I do and how can I do it? Will my students learn more or differently? Our third motivation is to provide a forum where faculty can share their work in computer-enhanced learning most effectively so that they can get feedback and be recognized for their innovations. An *imej* journal is an ideal medium for their publications.

A great deal has been written in the abstract about computer-enhanced learning. There has been the usual hype and over-raising of expectations, followed by the usual disappointment or skepticism. Many of the articles are thought-provoking, but more often than not they lack particulars. The purpose of *IMEJ* is to respond to the public's interest in a useful and concrete way. We would like to allow educators to tell how they have used learning technology, to describe what has worked and what has failed. Our intent is that readers can take away an idea applicable to their own teaching.

Assessment

The element most lacking in research about computer-enhanced learning is objective assessment of the effectiveness of particular applications. In many cases, educators have only begun experimenting with their ideas. The arguments for the success of their projects are often intuitive and anecdotal -- because assessing how much students learn is, after all, very difficult. In the main, the validity of anecdotal results is apparent. At the same time, we also desire to promote further research based on objective, statistical analysis.

We encourage *IMEJ* authors to include evaluation as an integral part of their ideas and projects. *IMEJ* seeks articles that describe -- in real terms and with testable interactive examples -- how computers have been used in learning, including a description of the pedagogical results of their efforts. We anticipate that a more rigorous assessment of learning technology will emerge as we build on our collective experiences, especially with the urging of scholarly publications.

Form

Multimedia Interactivity

Having acknowledged the great potential of multimedia interactivity, we'd now like to retrench a bit, for our first admonition to ourselves in the creation of *IMEJ* has been a reminder to use multimedia interactivity purposefully. It is tempting at times to do things simply because you *can* do them -- add a scrolling LED sign, make an image move, insert another picture, or plug in another audio file. But there are two very good reasons for restraint. The first is that if an academic journal hopes to be taken seriously, cultivating a glitzy image is certainly not the way to do it. Even more important is to keep in mind what a journal is all about. If the purpose of a journal is to inform or present new ideas, then its multimedia elements should be directed to that end. This isn't as boring as it sounds, as if we no longer value *engaging* our readers by first capturing their attention. Yes, we want a journal to be engaging, but we want, after all, to engage the readers in ideas and substance, and this can be done most effectively by focusing their attention and not annoying them with distractions.

It's just as easy to get carried away with hyperlinks. Hyperlinks have been a source of great enthusiasm among technology-minded writers. In the imaginative vein, they offer a non-linearity of text that opens new avenues for creative expression. In expository writing, hyperlinks proliferate for a different reason. Writers often see them as a service to the readers, pointing them to relevant information. Yet rather than offering an abundance of helpful information and related thoughts, as the writer may intend, these links can overwhelm the reader with a labyrinth of sidetracks, detours, and dead ends.

In summary, we offer the following guidelines for multimedia development, and recommend analogous ones to developers of *imej* journals in other subject areas.

- Use multimedia elements for clarification, explanation, and illustration. Allow the user to experiment and try things out, in an environment where it is clear what to do (Figure 1).
- For demonstrations of applications or programs implemented by the author, consider using scaled-down simulations rather than providing external links to the full application. (See http://imej.wfu.edu/articles/WFUAcadia/index.asp, which simulates exploring a Lotus Notes/Wake Forest Template database.) This has a number of advantages: The readers' attention can be directed to the features under discussion; the readers can be instructed more clearly in how to run the example; and the simulation can be maintained at the journal's own Web site, avoiding the danger of a dead link[1] in the paper if the author's application is later moved.

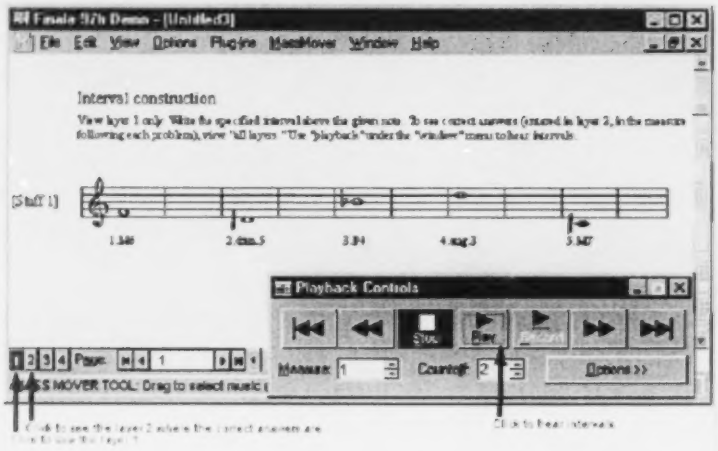

Figure 1: Instructions for interactive multimedia are clearly labeled and marked with arrows.

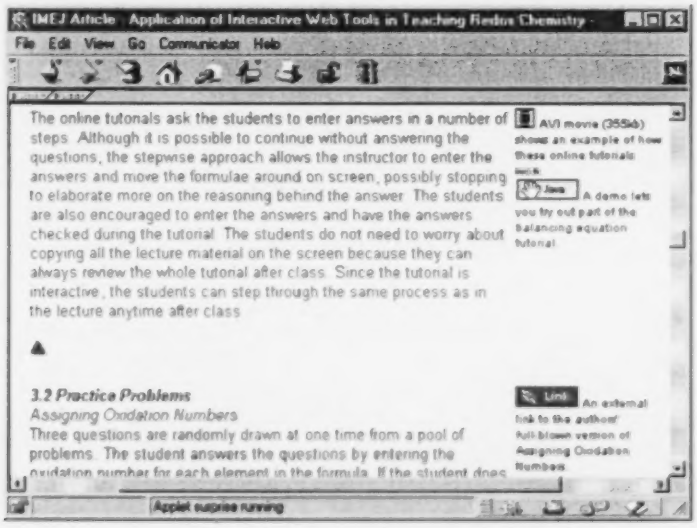
IMEJ Article - Application of Interactive Web Tools in Teaching Redox Chemistry
File Edit View Go Communicator Help
The online tutorials ask the students to enter answers in a number of steps. Although it is possible to continue without answering the questions, the stepwise approach allows the instructor to enter the answers and move the formulae around on screen, possibly stopping to elaborate more on the reasoning behind the answer. The students are also encouraged to enter the answers and have the answers checked during the tutorial. The students do not need to worry about copying all the lecture material on the screen because they can always review the whole tutorial after class. Since the tutorial is interactive, the students can step through the same process as in the lecture anytime after class.
AVI movie (355kb) shows an example of how these online tutorials work.
A demo lets you try out part of the balancing equation tutorial.
3.2 Practice Problems
Assigning Oxidation Numbers
Three questions are randomly drawn at one time from a pool of problems. The student answers the questions by entering the oxidation number for each element in the formula. If the student does
Link
An external link to the authors' full-blown version of Assigning Oxidation Numbers
Applet suprise running

Figure 2: Reader has a choice between a self-propelled demo and an interactive one. Links to full applications at external Web sites are marked as such.

[1] *Dead links* are links that lead to Web pages that no longer exist or are otherwise inaccessible.

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- Consider offering self-propelled demos (in the form of screencams, Java applets, etc.) alongside interactive ones so that readers can see how things are supposed to work before they try them out themselves (Figure 2).
- As much as possible, limit external links[2] in the text of an article. This helps the readers stay focused, since external links can lead to large Web sites that can be confusing or distracting. It also limits the number of hyperlinks that can later become dead links, which are a real annoyance to readers. Links to an author's fully-implemented application or to other external Web sites should be set aside from the text and marked as external (Figure 2). This points the readers to further information without sidetracking them as they are trying to understand particular points.

Design and Layout

In the design of *IMEJ*, we have sought a clean, uncluttered look and interactive elements that are easy to use and adaptable to different user environments. Again, the versatility of Web publication can be a trap, leading to screens crowded with frames, toolbars, and buttons, and requiring too many steps from one page to the next. Simplicity, clarity, and usability should remain foremost design principles, as outlined in the following suggestions:

- Make windows as uncluttered as possible. Too many format selections, frames, and toolbars take up too much space and detract from user-friendliness.
- In navigation, make it easy for readers to return to previous pages. Have accessible arrows that lead back to the top. Don't spawn a new window unnecessarily.
- For portability, use the most general file formats in multimedia development, in the sense that they run on the widest variety of platforms. When more than one format is being offered, present concise and clearly labeled choices (Figure 2). If possible, dynamically detect the reader's environment so that multimedia elements can be presented in the appropriate format in a manner that is transparent to the user.
- Make articles easily printable and scrollable. We prefer allowing the reader to scroll continuously through an article rather than click through pages with a link. In this way, the full article can be easily printed directly from the Web page.
- Maximize information accessibility. Allow searches from multiple points of entry. In addition to global keyword searching, we also offer more precise queries on date of publication, author's name, and pedagogical approach. In addition, the reader can browse the search engine's list of pedagogical approaches
- Use a consistent format for articles. An article template can ultimately save time for the Web developers and ensure consistency of format, especially when new Web developers are brought onto the journal staff.

Unique Challenges and Issues for *imej* Journals

Collaboration

One of the unique characteristics of online publication is its collaborative nature. On the one hand, an *imej* journal should have its own multimedia development team who have developed standards for multimedia design and layout. On the other hand, authors contributing articles to *imej* journals -- especially on the subject of computer-enhanced learning -- are likely to be adept computer-users themselves. Some may have created their own applications in learning technology, they generally have their own ideas about how their material should be presented, and in many cases they have already put it online. Creating the appropriate multimedia elements for their articles, however, does not involve merely inserting a link to their already-existing Web site. We envision a journal that is coherent in design and layout and articles that are focused and self-contained, with restraints on the number of links leading to Web sites that we cannot maintain ourselves. Consequently, development of an *imej* article necessitates a kind of collaboration between author, editors, and multimedia developers not required in other kinds of journals.

Thus far, the collaboration has gone more easily than one might expect. We've had to give up publication of only one article so far, by mutual consent with the authors, who preferred a multimedia layout inconsistent with our design. All other articles have been developed fairly smoothly through an exchange of ideas, suggestions, and files in the needed format.

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[2] We define an *external link* as a link to a Web page not maintained on our own server.

Discussion Forums and Peer Review

Feedback from readers of *imej* journals can come from two sources: the initial peer review of articles, and subsequent comments from readers through online discussion forums. Some electronic journals are combining these two steps in their overall procedure for editorial review of submitted articles (Shum and Sumner 1998).

All articles in *The IMEJ of Computer-Enhanced Learning* are carefully peer reviewed. Publishing articles from all disciplines of higher education (and a few from K-12), *IMEJ* has Editorial Board members from a wide variety of fields. Our editorial procedure is to assign the coordination of review of an article to an Editorial Board member in a discipline close to that of the article's content. That Board member finds three readers and handles the review process. Details are at http://imej.wfu.edu/infoforauthor.asp.

IMEJ offers a discussion forum for an article at the request of its authors. The forum is a service both to the authors, who often would like feedback on what they're doing, and the readers, who may seek more information or exchange of ideas. The discussion forums are generally unmoderated. However, we urge the authors to read their discussion forum and respond to comments. We also will delete any harassing comments from the forum at the authors' request.

Copyright and Archiving

Another unique feature of online publication is its dynamic nature. As opposed to hard-copy publications, online articles are easily edited and changed. However, for practical reasons -- so that they can be copyrighted, properly cited, and archived, for example -- it is necessary to arrive at a final version of articles.

IMEJ's policy is to post preprints of articles about a month before final publication of an issue, giving authors a last chance to make changes. At the release of an issue, the article is fixed in form. After that time, the only changes we foresee are the possible labeling of dead links or the addition of dated addenda or errata pages by the author.

IMEJ requires copyright for all articles. The copyright agreement states that the article has not been and will not be republished elsewhere, it will not be reproduced without permission of *IMEJ*, and it will not be made available online at any Web site other than *IMEJ*'s. Links to the article can be made from any other Web site, however. The copyright agreement also allows us to make copies of any issue for transport or archiving on portable secondary storage such as CD's or DVD's. Our copyright information is available at http://imej.wfu.edu/infoforauthor.asp#copyright.

Archiving raises new problems in electronic journals. If an article is to be considered a reference of some lasting value, it must be accessible over time. A number of questions arise. How long should issues remain online? In what format should they be archived after this time? If they are kept on disk, how much disk space will be required? If they are kept in some other format, how long will that format last physically (e.g., what is the shelf-life of a CD?) How long will that format be viable technologically? (e.g., will there be CD players around 20 years from now?) How will the journal handle requests for copies of articles that are archived? What happens if a journal folds? Who will handle requests for archived articles if there is no longer anyone on the journal staff?

Our policy decision at present is to keep issues online for at least two years. After that, they will remain on secondary storage, but active links to back issues may no longer be available at the journal's Web site. Archives will be protected by a standard backup policy. We are considering making archive copies in other formats as well, such as CD's, DVD's, and/or traditional printed form. The journal staff will handle requests for archived articles by sending electronic copies or printed versions. Back issues will be stored in the Wake Forest University Archives.

Conclusion

We have offered the conclusions drawn from our experience in developing an *imej* journal in the hope that they may be of use to others with similar interests. This is where we are in our thinking in April of 1999, with *IMEJ*'s inaugural issue to appear at the end of the month. The potential value of interactive multimedia scholarly publication is certainly worth exploring, and our initial foray into the area indicates that the special editorial and production challenges are not a bar to its development.

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